
द्रवीय पेट्रोलियम गैस भंडारण का संयंत्र —
रीति संहिता

भाग 2 औद्योगिक, वाणिज्यिक तथा घरेलू के
अधिक मात्रा में भंडारण के संयंत्र

(दूसरा पुनरीक्षण)

**Liquefied Petroleum Gas Storage
Installations — Code of Practice**

**Part 2 Commercial, Industrial and Domestic
Bulk Storage Installations**

(*Second Revision*)

ICS 23.020.35; 77.160.30

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भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली – 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

FOREWORD

This Indian Standard (Part 2) (Second Revision) was adopted by the Bureau of Indian Standards on recommendation of the Gas Cylinders Sectional Committee, had been approved by the Mechanical Engineering Divisional Council.

This Code was formulated with a view to recommend basic safety requirements and practice for the design, construction and safe operation of storage and ancillary facilities for LPG. Wherever these recommendations conflicts with the statutory regulations framed by the Statutory authority and Local Fire Brigade Authorities then the latter shall prevail.

This standard was first published in 1972 and subsequently revised in 2001. In this revision necessary changes have been made for better implementation of this standard. Major changes are as follows:

- a) Scope modified;
- b) LPG storage tanks capacity modified; and
- c) Reference standards updated.

The other part of this standard is given below:

IS 6044 (Part 1) Liquefied Petroleum Gas Storage Installations — Code of Practice Part 1 Residential, commercial and industrial cylinder installations.

In using this standard, IS 4576 which lists the various types of LPG generally marketed, shall be borne in mind.

In using this standard, the static pressure vessel code which is being framed by the statutory authority statutory authority shall be borne in mind.

While implementing this standard, compliance with statutory regulations shall be ensured.

The composition of the Committee responsible for the formulation of this standard is given in Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard***LIQUEFIED PETROLEUM GAS STORAGE
INSTALLATIONS — CODE OF PRACTICE****PART 2 COMMERCIAL, INDUSTRIAL AND DOMESTIC
BULK STORAGE INSTALLATIONS***(Second Revision)***1 SCOPE**

1.1 This standard (Part 2) lays down the code of practice for LPG bulk storage installations where storage tanks over 1 000 litres water capacity are used at commercial, industrial and domestic consumer premises.

1.2 This standard is not intended to cover LPG storage installations at:

- a) Refineries and cylinder/container filling plants;
- b) LPG-air distribution plants;
- c) Aerosol plants and;
- d) Auto LPG stations; and
- e) Any unit where LPG is not used as a fuel.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, editions were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
		(Part 3) : 2017	Mechanical properties of fasteners made of carbon steel and alloy steel — Bolts, screws and studs (<i>Fifth Revision</i>)
		1979 : 1985	High test line pipe (<i>second revision</i>)
		2501 : 1995	Solid drawn — Copper tubes for general engineering purposes (<i>third revision</i>)
		2825 : 1969	Code for unfired pressure vessels
		3043 : 2018	Code of practice for earthing (<i>second revision</i>)
		3710 : 1978	Filling ratios for low pressure liquefiable gas (<i>first revision</i>)
		4712 : 1984	Forged steel, socket-welding fittings (<i>first revision</i>)
		4864 : 1968	Shell flanges for vessels and equipment: General requirements
		6044 (Part 1) : 2018	Liquefied petroleum gas storage installations — Code of practice: Part 1 Residential, commercial and industrial cylinder installations (<i>third revision</i>)
1239	Steel tubes, tubulars and other wrought steel fittings	IS/ISO 3183 : 2007	Petroleum and natural gas industries — Steel pipe for pipeline transportation systems
(Part 1) : 2004	Steel tubes (<i>sixth revision</i>)		
(Part 2) : 2011	Steel pipe fittings (<i>fifth revision</i>)	IS/IEC 60079-1 : 2014	Explosive atmospheres: Part 1 Equipment protection by flameproof enclosures “d” (<i>first revision</i>)
1367	Technical supply conditions for threaded steel fasteners		
(Part 1) : 2014	General requirements for bolts, screws, studs and nuts (<i>fourth revision</i>)	IS/IEC 62305-1 : 2010	Protection against lightning: Part 1 General principles
(Part 2) : 2002	Tolerances for fasteners — Bolts, screws, studs and nuts — Product grades A, B and C (<i>third revision</i>)	IS/IEC 62305-2 : 2010	Protection against lightning: Part 2 Risk management
		IS/IEC 62305-3 : 2010	Protection against lightning: Part 3 Physical damage to structures and life hazard

3 LOCATION OF STORAGE TANKS AND REGULATING EQUIPMENT

3.1 Location and Spacing

3.1.1 Storage tanks and first stage regulating equipment if used, shall be located outside of buildings.

3.1.2 Each individual tank shall be located with respect to the nearest important building or group of buildings or line of adjoining property which may be built on in accordance with Table 1. The distances given refer to the horizontal distance in plan between the nearest point of the storage tank and building/property line.

3.1.3 In heavily populated or congested areas the authority having jurisdiction may determine the need for other reasonable protective methods to be taken, such as, provision of fire walls, etc.

3.1.4 If fire walls are to be provided, the authority having jurisdiction may determine the extent to which the safety distances for above-ground tanks may be reduced.

3.1.5 Storage tanks shall not be installed one above the other.

3.1.6 No LPG tank (s) shall be located within the banded enclosures of any other petroleum installation. The minimum distance of separation between LPG

storage tanks and any petroleum installation shall be as prescribed under the *Petroleum Rules*, 2002 or as prescribed under SMPV Rules or as per distance specified above in Table 1, whichever is more.

3.1.7 The number of storage tanks in one storage installation shall not exceed six. In case there are more than one storage installations, the safety distance between two installations shall be the same as the distance between the tanks and the property line in accordance with Table 1.

3.2 Bunding

Above ground vessel for storage of corrosive, flammable or toxic gas in liquefied state shall be provided with enclosure wall all around the ground. The minimum distance between vessel and enclosure wall shall be the diameter of the vessel or 5 m, whichever is less. The ground shall be graded to form a slope away from pumps, compressors or other equipment. The height of the enclosure wall shall be 30 cm on the upper side and gradually increasing to maximum 60 cm on the lower side, at the end of which a shallow sump for collection of the spilled liquid, if any, shall be provided. The minimum separation distance between the vessel and the sump shall be,

- a) diameter of the vessel, in case of vessels with water capacity not exceeding 40 000 litres; and

Table 1 Minimum Safety Distances for Liquefied Flammable Gases

(Clauses 3.1.2, 3.1.6 and 3.1.7)

Sl No.	Water Capacity of Vessel (in litres)	Minimum Distance From Building or Group of Buildings or Line of Adjoining Property (m)		Minimum Distance Between Vessels (m)	
		Above Ground Level	Underground or Above Ground Vessels Covered With Earth (Mound)	Above Ground Level	Underground or above Ground Vessels Covered with Earth (Mound)
(1)	(2)	(3)	(4)	(5)	(6)
i)	Not above 2 000	5	3	1	1
ii)	Above 2 000 but not above 7 500	10	3	1	1
iii)	Above 7 500 but not above 10 000	10	5	1.5	1
iv)	Above 10 000 but not above 20 000	15	7.5	2	1
v)	Above 20 000 but not above 40 000	20	10	2	1
vi)	Above 40 000 but not above 350 000	30	15	2 or 1/4 th of the sum of dia of adjacent vessel or 1/2 the dia of the two adjacent vessels, whichever is greater	1
vii)	Above 350 000 but not above 450 000	40	15		1
viii)	Above 450 000 but not above 750 000	60	15		1
ix)	Above 750 000 but not above 3 800 000	90	15		1
x)	Above 3 800 000	120	15		1

- b) 15 m, if the water capacity of the vessels exceeds 40 000 litres.

3.3 Protection

3.3.1 To prevent trespassing or tampering, the area which includes tanks, vaporizers, pumping equipment and loading and unloading facilities shall be enclosed by an industrial type fence at least 2 m high along the perimeter of the safety zone. Any fence shall have at least two means of exit. Gates shall open outwards and shall not be self-locking.

3.3.2 When damage to LPG systems from the LPG tank lorry is a possibility, precautions against such damage shall be taken.

3.3.3 Underground tanks shall be protected from above-ground loading by providing a suitable curb to prevent a possible accidental damage to the tank and its fittings by LPG tank lorry.

4 STORAGE TANKS

4.1 Design Code

Storage tanks shall be designed, fabricated and tested in accordance with IS 2825 or such standards as laid down or approved by the Statutory.

4.2 Design Pressure

The design pressure of the tank shall be not less than the vapour pressure of the particular LPG to be stored at the highest temperature that the contents of the tank may reach in service. The maximum temperature as prescribed by the statutory authority, is 55°C for tank.

4.3 Fittings

4.3.1 General

- a) Each tank shall be provided with the following fittings:
 - 1) Pressure relief valve connected to the vapour space — 2 No.
 - 2) Independent liquid vessel indicators/gauge — 2 No.
 - 3) Pressure gauge connected to the vapour space
 - 4) Temperature Gauge — 1 No.
 - 5) High Level Alarm — 1 No.

Furthermore, each of these fittings shall be suitable for use with LPG at pressures not less than the design pressure of the tank to which they are fitted.
- b) All pipe joints shall be welded or flanged only except for valve and allied equipment fittings.
- c) All vessels shall have a manhole and the manhole shall be not less than 45 cm internal diameter. For underground vessels, the manhole shall be in the

form of an extended nozzle of sufficient length to bring the manhole cover above-ground level.

- d) All tank fittings of underground tanks shall be on the manhole cover if the tank is equipped with manhole. If the tank is not so equipped, the fittings shall be on extended nozzles so as to be accessible at ground level subject to protection under 3.3.3.

4.3.2 Pressure Relief

4.3.2.1 Relief valves shall be spring loaded and set to discharge at 100 percent and reach fill flow conditions within 110 percent of design pressure as required under 4.1. The design of the valves shall be such that they cannot be inadvertently overloaded and that it is not possible to temper with their pressure setting. Weight loaded relief valves are not permissible. Relief valves shall be constructed so that the breakage of any part will not obstruct the free discharge of vapour under pressure.

4.3.2.2 The full flow capacity of pressure relief valves for above-ground tanks shall be in accordance with Annex A. For underground tanks the full flow capacity of pressure relief valves maybe reduced to not less than 30 percent of the prescribed value in Annex A.

4.3.2.3 Every relief valve shall incorporate the following permanent markings:

- a) Manufacturer's name and valve type number;
- b) Date of manufacturing with batch number and serial number;
- c) Nominal inlet and outlet sizes;
- d) Start of discharge pressure; and
- e) Certified discharge capacity of air at atmospheric pressure.

4.3.2.4 If provision is made to isolate any relief valve for testing/servicing, then the remaining relief valves connected to the tank shall provide the full discharge capacity as per Annex A.

4.3.2.5 For above-ground tanks of over 4 500 litre water capacity and for all underground tanks, relief valves shall be fitted with extended vent pipes adequately supported and having outlets at least 2 m above the top of the tank and at least 3.5 m above-ground level. The vent pipes shall be fitted with loose fitting rain caps.

4.3.3 Shut-off and Emergency Shut-off Valves

4.3.3.1 All liquid and vapour connections on tanks, with the exception of those for relief valves, plugged openings and those where the connection is not greater than 1.4 mm diameter opening, shall have shut-off valves located at minimum 3 m from the shadow of the vessel.

4.3.3.2 All liquid and vapour connections on tanks with the exception of those for relief valves and drainage connections of small diameter, shall have an emergency shut-off valve, such as, an excess flow valve, an automatically operated valve or a remotely controlled valve. The emergency valve shall be in addition to the shutoff valve, mentioned in **4.3.3.1**, unless the valve is a remotely controlled valve which can be operated from a safe area and it is of a fail-safe type. Emergency shut-off valves are not considered necessary where the connection to tank is restricted to not greater than 3 mm diameter for liquid and 8 mm diameter for vapour.

4.3.3.3 Where the emergency shut-off valve is of the excess flow type, its closing rate of flow should be below that rate which is likely to result from a fracture of the line it is protecting.

4.3.3.4 Drain connections for larger tanks shall be provided with a shut-off valve which should be limited to 5 cm nominal size. The shut-off valve should be provided with a length of piping terminating with a second shut-off valve limited to 2.5 cm nominal size. The length of piping between the valves should be such that the risk of simultaneous obstruction of both valves is minimized. A sufficient length of piping should be provided downstream of the second valve to ensure that discharge will not take place beneath the tank. For smaller tanks, the shut-off valve should be limited to 2.5 cm size and its outlet should be provided with a screwed plug or blank flange containing a drain hole of maximum 3 mm size.

4.4 Filling Capacity

The maximum quantity of LPG filled into any tank shall be as per the licenced quantity for the vessel as issued by the Statutory authority or his representatives and shall be as per IS 3710.

4.4.1 The maximum tilling densities and corresponding maximum liquid content at 15.5 °C for LPG of various relative densities shall be as given in Annex B for both above-ground and underground tank installations.

4.5 Foundation for Above-Ground Tanks

4.5.1 Tanks shall be supported on concrete, masonry, or structural steel supports. In the case of structural steel supports, these supports, excluding tank saddles or supporting feet 45 cm or less in height, shall be encased in fire-resisting materials. The thickness of the fire-resisting material shall be in accordance with Table 2.

4.5.2 The design of tank supports and their attachment to the tank shall be in accordance with **4.1**.

4.5.3 Tank supports shall be designed to permit movement of tanks due to changes in temperature. (see Table 2).

Table 2 Material for Protection of Structural Steel Supports
(Clauses 4.5.1 and 4.5.3)

Sl No.	Protective Material	Minimum Thickness (cm)
(1)	(2)	(3)
i)	Plaster :	
	a) Vermiculite plaster	4.5
	b) Perlite plaster	4.5
	c) One layer gypsum wallboard, with 5 cm perlite over 1 cm gypsum board, 1.5 cm scratch coat and 3.5 cm brown coat	6.5
ii)	Concrete (completely encased)	5
iii)	Brick	10
iv)	Hollow tile (semi fireproof clay or shale with wire mesh in horizontal joints, recentrant space filled with concrete)	10

4.5.4 The design and construction of foundations shall be based on the load bearing capacity of the ground, its settlement characteristics, and the risk of flotation. The loadings shall take into account the static load of the tank and its contents (product or water if water tested) and wind loads.

4.6 Painting of Above-ground Tanks

Tanks and their supports shall be adequately painted externally to prevent corrosion with a sun reflective paint such as white or as per colour approved by statutory authority . Aluminum paint shall not be used for this purpose.

4.7 Installation of Underground Tanks

4.7.1 Tank(s) shall be set on RCC concrete foundation, buried in a masonry pit and shall be surrounded with sweet sand. Where the water table may be high, tanks shall be securely anchored or weighted to prevent floating. The backfill material shall be free of rocks or other abrasive materials and shall be carefully consolidated. It is recommended that minimum 60 cm of cover should be provided on over the top of the tank, or any other recommendations as per statutory authority's approval condition.

4.7.2 It is recommended that specialist's advice should be obtained on cathodic protection of tanks, including coating materials and application of epoxy base paint as recommended in NFPA -58 or any other as per statutory authority's license condition.

4.8 Marking of Tanks

Each tank shall be conspicuously and permanently marked to include the following:

- a) Pressure vessel code to which it is made;

- b) Manufacturer's name and serial number
- c) Water capacity in litres;
- d) Maximum safe working pressure;
- e) Hydrostatic test pressure;
- f) Test date; and
- g) Third party inspection agency name and its punch.

5 PIPING VALVES AND FITTINGS

5.1 Materials

5.1.1 All materials including non-metallic parts for valves, seals, gaskets, and diaphragms shall be resistant to the action of LPG under the service conditions to which they are subjected.

5.1.2 Cast-iron piping materials shall not be used.

5.1.3 Seamless steel pipe is recommended. Electrical resistance welded steel pipe normalized throughout its length may be used.

5.1.4 Copper pipe or tubing shall be seamless and shall only be used for sizes 20 mm and under.

5.1.5 Steel pipe shall conform to IS 1239 (Part 1) and IS/ISO 3183 : 2007.

5.1.6 Copper pipe shall conform to IS 2501.

5.2 Pipe Thickness

To be decided as per design parameter of the system.

5.3 Pipe Joints

5.3.1 Pipe joints shall be welded or flanged.

5.3.2 The fabrication of pipe work by fusion welding shall be carried out.

5.4 Valves

Valves shall be of cast steel. Only ball valves shall be used. Cast iron valves shall not be used.

5.5 Flanges and Fittings

5.5.1 Steel flanges and flanged fittings shall conform either to Section IV of IS 2825 or IS 4864.

5.5.2 Slip-on or welded neck flanges or screwed flanges may be used for sizes of 5 cm or smaller.

5.5.3 Steel butt welded fittings shall be at least of the same schedule thickness as the pipe.

5.5.4 Steel socket couplings and fittings shall be in accordance with IS 4712 and may be either welded or screwed type.

5.5.5 Steel unions shall be in accordance with IS 1239 (Part 2). They should have ground metal-to-metal seats; gasket type unions shall not be used.

5.5.6 Plugs shall be solid steel plugs or steel ball plugs. Cast iron or brass plugs shall not be used.

5.6 Bolting

Bolting shall be supplied according to IS 1367 (Parts 1 to 3).

5.7 Installation and Testing

5.7.1 Liquid and vapour pipelines shall be installed so as to have adequate 'flexibility to accommodate any settlement of tanks or other equipment, thermal expansion, or contraction or any other stresses which may occur in the pipe work system.

5.7.2 Any equipment or section of pipeline in which liquid may be trapped, for example, between shut-off valves, shall be protected against excessive pressure caused by thermal expansion of the contents. The minimum setting of relief valves provided for this purpose shall be not less than the maximum pressure, under normal operating conditions, of the section of pipeline which they are protecting. If pressure relieving devices discharge to atmosphere, the discharge should be arranged in a safe manner.

5.7.3 All pipeline system after installation shall be proved free from leaks at the following pressure or at the maximum operating pressure whichever is higher (see also 5.8).

- a) Vapour pipelines (upstream and downstream at 1.5 times working pressure); and
- b) Liquid pipelines (downstream) at 1.5 times working pressure.

5.7.4 Piping both underground and above-ground be protected against physical damage and corrosion.

5.8 LPG Inside Premises

LPG in either the liquid or vapour phase shall not be piped inside premises at pressures in excess of 1.5 kg/cm² gauge.

NOTE — Piping, fittings and valves installed inside premises shall be in accordance with relevant clauses of IS 6044 (Part 1).

6 HOSES, PUMPS, COMPRESSORS, AND METERS USED FOR TRANSFER OF LPG

6.1 Hoses

6.1.1 The design, materials, and construction of hoses shall be suitable for the grade of LPG which they are to handle. They shall be tested at 30 kgf/cm² during initial manufacture and designed to withstand a minimum bursting pressure of four times the maximum pressure they will carry in service.

6.1.2 Hoses shall periodically be tested for electrical continuity, the frequency of the test depending on the amount of use.

6.1.3 Excess-flow valves, automatically operated valves, or remotely controlled valves or of quick shutoff couplings to be installed in pipelines to which hoses are connected to prevent discharge of LPG in the event of failure of the hose.

6.2 Pumps, Compressors and Meters

6.2.1 The design, materials, and construction of pumps, compressors and meters shall be suitable for the type of LPG which is to be handled, and they shall be designed for the maximum outlet pressure to which they will be subjected in operation.

6.2.2 Seals used shall be of the mechanical type.

6.2.3 Positive displacement pumps and compressors shall have a by-pass or other suitable pressure relieving device against over pressure.

7 VAPORIZERS

7.1 General

7.1.1 Vaporizers maybe low pressure steam heated, hot water heated, electrically heated, or ambient water/air.

7.1.2 Vaporizers shall be of sufficient capacity to supply the latent heat of vaporization necessary to convert the liquid into vapour at the maximum off-take required from the installation.

7.1.3 Where necessary, precautions against the accumulation of condensate in the vapour discharge line shall be taken. This may require insulation of the vapour discharge line or, in cold areas, the provision of condensate pockets capable of containing the quantity likely to be condensed during a plant shut-down.

7.1.4 With steam and hot water heated vaporizers, care shall be taken to avoid freezing of the steam condensate of water. Ice may be formed when exceptionally high vapour withdrawal rates cause excessive cooling of the liquid LPG in the bottom of the vaporizer.

7.1.5 If a vaporizer system is provided with a drain, the discharge should be arranged at a safe place.

7.1.6 Vaporizers shall not be fitted with fusible plugs.

7.1.7 Heating coils shall not be installed inside a storage tank to act as a vaporizer.

7.1.8 Valves shall be installed to shut-off the liquid and/or the vapour connection between the storage tank and the vaporizer.

7.1.9 Vaporizers shall not be installed in a building except where the building is used exclusively for gas manufacture or distribution. Such buildings should be of non-combustible construction and well ventilated near the floor line and roof.

7.1.10 Vaporizers shall be installed at a minimum distance of 2 m from the nearest storage tank. No combustible material shall be stored within the safety zone.

7.2 Construction

7.2.1 Vaporizers shall be designed and tested in accordance with a recognized and appropriate pressure vessel code, for example, for vaporizers (*see* IS 2825).

7.2.2 Each vaporizer shall be marked to include the following :

- a) Pressure vessel code to which it is made;
- b) Manufacturer's name and serial number;
- c) Maximum working pressure and temperature;
- d) Vaporizing capacity, in kg/h;
- e) Year in which it is made;
- f) Dates of tests; and
- g) Statutory authority approval number and date;

7.3 Pressure Relief Devices

7.3.1 Vaporizer systems shall have, at/or near the vapour discharge, a pressure relief valve or valves which are set to discharge and which will reach full flow conditions as required by the code to which the vaporizer is designed and constructed.

7.3.2 The pressure relief valve or valves shall provide an effective rate of discharge in accordance with **7.3.3**.

7.3.3 The minimum required rate of discharge shall be obtained as follows:

- a) Obtain the total surface areas by adding the surface area of the vaporizer and heat exchanger directly in contact with the liquid LPG; and
- b) From Annex A, obtain the minimum required rate of discharge in cubic metre of air per minute at 15.5°C and one atmosphere pressure.

7.4 Liquid Control

7.4.1 The liquid level control maybe integral with the vaporizer vessel or fitted separately adjacent to the vapour discharge from the vaporizer vessel.

7.4.2 Vaporizers shall be provided with suitable automatic means to prevent liquid LPG passing through the vaporizer to the gas discharge piping.

7.5 Heat Input Control

7.5.1 The heat input shall be suitably controlled to prevent the pressure in the vaporizer vessel reaching the start-to-discharge pressure of the pressure relief valve or valves in the vaporizer system.

7.5.2 The heating medium lines leading into and leaving the vaporizer shall be provided with a suitable means for preventing the flow of LPG into the heating system in the event of tube rupture in the vaporizer.

7.6 Connections Between Vaporizer and Storage Tank

The vaporizer may be connected to a vapour phase position on the storage tank in addition to the connection to the liquid phase position. The necessary liquid controls under 7.4, and heat input control under 7.5 shall be designed to suit the arrangement employed.

8 GENERAL SAFETY REQUIREMENTS

8.1 Static Electricity and Lightning Protection

Earthing and bonding, telecommunications and instrumentation shall be in accordance with IS/IEC 62305-1, IS/IEC 62305-2, IS/IEC 62305-3 and IS 3043.

8.2 Hand torches, if used shall be of approved flameproof type.

8.3 All electrical installations within the safety zone shall be of flame-proof type conforming to IS/IEC 60079-1.

8.4 Grass and Weed Removal

Readily ignitable material, such as, weeds, long grass or any combustible material shall be removed from an area within 3 m from the shell of any LPG tank of up to 2 000 litre water capacity, and within 6m from the shell of larger tanks. If weed killers are used, chemicals which are a potential source of fire hazard shall not be selected for this purpose.

8.5 Warning Signs

No smoking or no naked flames shall be permitted within the safety zone of the installation. Prominent, notices to this effect shall be posted at access points.

9 TRANSFER OF LPG

9.1 From Road Tank-Lorries

9.1.1 A minimum safety distance of 9 m shall be maintained between:

- a) centre line of tank-lorry hard standing/discharge point and the adjoining property; and
- b) centre line of the tank-lorry hard standing and the storage tank shell.

9.1.2 The tank-lorry hard standing shall be within the fence area of the storage installation.

9.2 Instructions given in Annex C shall be strictly observed during the transfer of LPG from road tanker to the installed tanks.

10 FIRE PROTECTION

10.1 General

The possibility of a major fire outbreak, leading to direct flame impingement of the storage tank, shall be minimized by sound engineering in plant design and layout, good operating practice, and proper education and training of personnel on both routine operations and on action to be taken in an emergency. Fire organ gram chart shall be displayed at the storage area indicting the roles of the employees and role specific training shall be imparted to the employees. Mock drills shall be conducted once in 6 months and records of the same shall be maintained.

10.2 Water Supply

Provision shall be made for an adequate supply of water and fire protection in the storage area according to the local fire services regulations, or minimum arrangements shall be made for spraying of water at the rate of 10 litre/min on each vessel in the bund. Spraying of water to be arranged in the LPG pump/compressor house also. The fixed water spray system shall be automatic. The additional application of water may be by hydrants fixed monitors and through mobile equipment. Control of water flow should be possible from outside any danger area.

10.2.1 Hydrants, where provided, shall be readily accessible at all time and so spaced as to provide for the protection of all tanks.

10.2.2 Sufficient lengths of fire hose shall be provided and be readily available. It is desirable to equip the outlet of each hose line with a combination jet and fog nozzle. These should be in good condition and periodically inspected.

10.2.3 Mobile equipment field monitors, or fixed spray systems shall be designed to discharge water at a rate sufficient to maintain an adequate film of water over the surface of tank and support under fire conditions.

10.2.4 Provision shall be made for mobile or fixed water-spray systems giving suitable and effective protection for road tanker and rail tank car loading and unloading areas.

10.3 Fire Extinguishers

At least two numbers per vessel of 9 kg capacity dry chemical powder type/ABC type and one number of 50 kg capacity dry chemical powder type wheel mounted fire extinguishers shall be positioned near the storage area. Two numbers of 9 kg capacity dry chemical powder type/ABC type fire extinguisher shall

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be provided at each access point to the installation. In addition, minimum two numbers of 9 kg DCP (dry chemical powder type)/ABC type fire extinguishers shall be positioned at the product transfer area, that is, tank truck unloading area.

10.4 Gas Monitoring System

Gas monitoring system with local as well as remote alarm system shall be provided for all bulk installations. Two nos. of detectors shall be provided per vessel: 1 number on the top and 1 number near bottom of the ROV.

ANNEX A

[(Clauses 4.3.2.2, 4.3.2.4 and 7.3.3(b))]

**CAPACITY OF SAFETY VALVES (IN CUBIC METRES PER MINUTE OF AIR
WITH RESPECT TO SURFACE AREA OF THE PRESSURE VESSEL)**

<i>Surface Area</i> m ²	<i>Flow Rate</i> m ³ /min of Air	<i>Surface Area</i> m ²	<i>Flow Rate</i> m ³ /min of Air	<i>Surface Area</i> m ²	<i>Flow Rate</i> m ³ / min of Air
(1)	(2)	(1)	(2)	(1)	(2)
2.0	19	15.5	102	56	292
2.5	23	16.0	106	61	315
3.0	27	16.5	108	66	335
3.5	31	17.0	111	71	356
4.0	34	17.5	114	76	377
4.5	37	18	116	81	398
5.0	42	19	121	86	418
5.5	44	20	126	91	437
6.0	46	21	132	96	459
6.5	50	22	137	101	476
7.0	54	23	142	106	495
7.5	56	24	147	111	513
8.0	58	25	152	116	533
8.5	62	26	158	121	550
9.0	65	27	162	126	570
9.5	68	28	166	131	589
10.0	71	29	174	136	607
10.5	75	30	178	141	625
11.0	77	31	183	146	644
11.5	81	32	187	151	662
12.0	83	33	192	156	680
12.5	86	34	195	161	698
13.0	88	35	200	166	715
13.5	91	36	204	171	733
14.0	94	41	227	176	751
14.5	97	46	250	180	765
15.0	99	51	272	-	-

ANNEX B

(Clause 4.4.1)

MAXIMUM FILLING DENSITIES AND CORRESPONDING MAXIMUM LIQUID CONTENT AT 15.5 °C FOR LIQUEFIED PETROLEUM GASES OF VARIOUS RELATIVE DENSITIES

LPG Relative Density at 15.5 °C	Above-Ground Containers		Under Ground Containers	
	Filling Density	Maximum LPG Content at 15.5 °C Volume	Filling Density	Maximum LPG Content at 15.5 °C Volume
	Percent	Percent	Percent	Percent
(1)	(2)	(3)	(4)	(5)
0.496-0.503	41	82.6-81.5	45	90.7-89.4
0.504-0.510	42	83.3-82.3	46	91.2-90.2
0.511-0.519	43	84.1-82.8	47	91.9-90.5
0.520-0.527	44	84.6-83.5	48	92.3-91.1
0.528-0.536	45	85.2-83.9	49	92.8-91.4
0.537-0.544	46	85.6-84.5	50	93.1-91.9
0.545-0.552	47	86.2-85.1	51	93.5-92.3
0.553-0.560	48	86.8-85.7	52	94.0-92.9
0.561-0.568	49	87.3-86.3	53	94.4-93.4
0.569-0.576	50	87.9-86.7	54	94.9-93.7
0.577-0.584	51	88.4-87.4	55	95.3-94.2
0.585-0.592	52	89.9-87.8	56	95.8-94.5
0.593-0.600	53	89.4-88.3	57	96.1-95.0

ANNEX C

(Clause 9.2)

INSTRUCTIONS FOR TRANSFER OF LPG

C-1 OPERATIONS**C-1.1 Training**

The following recommendations apply to domestic, industrial and commercial installations.

C-1.1.1 Those responsible for the operation of equipment and the handling of LPG should understand the physical characteristics of the product and be familiar with the relevant sections of this code relating to their spheres of responsibility.

C-1.1.2 Responsible personnel should be trained in the fundamentals of fire-fighting and fire-control with particular reference to fires involving LPG. They should also be trained in the correct handling of any fire fighting and fire-control equipment provided and should be exercised in this respect at frequent intervals. The location of all gas and liquid piping and valves should be known and their use understood.

C-1.2 Product Transfers

C-1.2.1 SOP must be displayed at the point of product transfer.

C-1.2.2 Before LPG is transferred from a container to any other container whether it is a storage tank, road tanker, rail tank car, or portable container, the following procedure should be followed:

- a) Receiving container should be checked to ensure that it is in safe working condition and that it is not to be filled with a grade of LPG for which it is not designed.
- b) Receiving container should be checked to ensure that it has sufficient ullage to receive the parcel being transferred to it.
- c) Inter-connecting system, that is, pipework, fittings, valves, hoses, etc, should be checked to ensure that it is in safe working condition and that only valves, etc, required for the transfer operation, or any other operation proceeding simultaneously, are open.
- d) Inner-connecting systems should be checked to ensure that product cannot be charged into lines, equipment or containers not designed to handle it and that unacceptable product contamination will not occur.

C-1.2.3 During LPG transfers from container to container and on completion of the operation, the receiving container should be checked to ensure that

it is not being overfilled and on completion is not filled above its safe working level.

C-1.2.4 In this case of road tankers and rail tank cars, in addition to the requirements of **C-1.2.1** and **C-1.2.2**, the following procedure should also be followed:

- a) The vehicle should be prevented from accidental movement during the transfer operation. The parking brake of a road tanker or the hand brake of a rail tank car should be on and, where necessary, wheel chock blocks should be used;
- b) The earthing connection to the tanker at the time of unloading shall be interlocked with the unloading pump/compressor so as to ensure that decantation/unloading from the tanker doesn't start without proper earthing connection. Provision must also be made to ensure that in case of any discontinuity in the earthing connection of the tanker, the unloading operation must stop automatically;
- c) Any driving units or electrical equipment not required and not specifically designed for the transfer operation should be stopped and/or isolated;
- d) The tank of a road tanker should be electrically connected to the fixed installation before any product transfer operation is carried out; and
- e) Before the vehicle is moved, the electrical and the liquid and vapour connections should be disconnected, care being exercised to avoid spillage. Where wheel chock blocks have been used they should be removed. The vehicle should be checked to ensure that any LPG that has leaked or has been vented has safely dispersed.

C-1.3 Draining of Tanks

Particular care should be exercised when draining water from tanks in order to prevent escape of LPG. All tanks should be with two drain valves. The valve nearer the tank should be opened first and draining controlled by gradually opening the valve further from the tank. On completion of the draining operation, the valve further from the tank should be closed first, then the valve nearer to the tank. The drain line must be placed immediately after the automatic/remote operated valve of the vessel and must be taken beyond the shadow area of the vessel. It is recommended to depute 2 manpower for the draining operation. SOP for draining must be displayed near the draining point.

C-1.4 Attendance during Operations

C-1.4.1 A competent person shall remain in attendance during all transfer operations and should ensure that when transfers take place outside a petroleum or other protected area, the necessary warning notices against smoking and the use of naked lights are displayed and that the requirements of **C-1.2** are complied with.

C-1.4.2 No drain valve, bleed valve, pipeline, etc. in the LPG system which communicates directly to the outside air should be left open without an operator in attendance.

C-1.4.3 If it is necessary to discontinue temporarily a vehicle loading operation, and return later to complete it, the loading hose should be disconnected from the vehicle for the period of absence.

C-1.4.4 The person-in-charge of operations should ensure that transfer operations are stopped and all valves closed in the event of the following occurrences:

- a) Uncontrolled leakage,
- b) A fire in the vicinity, and
- c) A severe electrical storm in the vicinity in the case of an operation which involves venting of LPG.

C-1.5 Lighting Storage and Operating Areas

Operations should not be carried out during the darkness unless adequate flameproof lighting is available.

C-1.6 Purging and Filling Tanks and Systems

C-1.6.1 When new tanks and systems are to be taken into commission or tanks and systems which have been gas-free are to be filled they should first be cleared of air.

C-1.6.2 Air should be replaced by an inert gas or water dependent on circumstances. If inert gas or water is used to replace the air, provision should be made for its complete removal.

C-1.6.3 In the case of air removal by means of an inert gas, sampling and testing of the tank contents and the mixture shall be done to determine the completeness of the air removal and the flammability of the issuing gas.

C-1.6.4 On filling the tank and the system, care should be taken to prevent excessive chilling by the too rapid evaporation of the LPG pumped into it.

ANNEX D*(Foreword)***COMMITTEE COMPOSITION**

Gas Cylinder Sectional Committee, MED 16

<i>Organization</i>	<i>Representative(s)</i>
Petroleum And Explosive Safety Organization, Nagpur	SHRI M. K. JHALA (Chairman) SHRI V. K. MISHRA (<i>Alternate I</i>) SHRI JAMUNALAL ROUT (<i>Alternate II</i>)
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